# *Implementation of Enhanced Forest Productivity: A Pilot Project on the Romeo Malette Forest*

## Partners Report – 2005 Field Season

**(FRP Project 120-501)**


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## *Implementation of Enhanced Forest Productivity: A Pilot Project on the Romeo Malette Forest*

# Executive Summary

### *Objective*

After five years of research involving more than 120 projects, the Forestry Research Partnership (FRP) has initiated a series of demonstration areas designed to operationally validate new and ongoing FRP products. These demonstration areas are the first on-the-ground manifestation of the FRP's strategy to increase wood supply in an ecologically sustainable context and will serve to close the loop on the adaptive management process adopted by the FRP as its science foundation. With the aim of maximizing productivity on these carefully selected "prime" sites, FRP products are being incorporated and implemented with existing state-of-the-art knowledge and tools as harvest-to-harvest sequences of silvicultural best-practices. This systematic approach will integrate advanced planning, intensive silviculture, enhanced protection, and thorough monitoring to create flagship illustrations of how silviculture can be used to improve, restore, and diversify Ontario's forests. As such, this project aims to act as a catalyst for enhanced productivity on the Romeo Malette Forest and other forests across Ontario.

### *Project Solutions*


***Members of the FRP's NE Enhanced Forest Productivity Core Team***

The project is being planned and implemented by a team that includes Tembec forest management staff, Ontario Ministry of Natural Resources personnel from the District and Northeast Science and Information Section, Millson Forestry Service, and the Canadian Forest Service. The team is working to merge high-tech inventory with leading-edge forest modeling, and silvicultural science with operational practice, to set the standard for the credible implementation of enhanced forest productivity. Specifically, integrated harvest-to-harvest sequences of best practices are being implemented that include such components as 1) state-of-the art spatial modeling to aid in prime site selection, 2) enhanced forest inventory to optimize operational planning, including block and road engineering, 3) careful, high-utilization logging, 4) thorough mechanical and/or chemical site preparation, 5) timely planting of high quality stock, including the best genetics available and species matched to microsite, 6) timely and effective vegetation management, and 7) density regulation defined by long-term crop plans. Within each of these components, new knowledge and tools are being fully implemented to operationally test and validate their integrity. Thorough silvicultural effectiveness monitoring will provide feedback to the FRP for the refinement of these products, as well as the generation of much-needed long-term growth and yield data for managed stands.

### *Methods*

The proposed demonstration areas will encompass approximately 1000 ha (actual area will be a product of the site-selection process), over a 3-year implementation period. The project will begin by matching Patchworks model identifications of prime sites with areas allocated for harvesting under the current forest management plan. The identified areas will therefore consist of sites that are candidates for intensive silviculture treatments (i.e., outside of habitation, riparian, and incompatible-values setbacks, with minimized user conflict, etc.), have potential for high productivity, and be in economic proximity to a processing facility. In general, we will seek forested areas to implement intensive planning at the pre-harvest stage. However, we will not overlook candidate sites that have recently been harvested or existing young stands with well-documented history and strong potential for response to additional silvicultural interventions. A range of forest types will be considered, including mixedwoods.

Existing stand conditions will be quantified using a series of 0.04-ha circular plots located on a 200-m grid (1% cruise). Data will be collected to quantify timber volumes and quality, understorey stand conditions, including Forest Ecosystem Classification, and characterize soils and terrain conditions. New remote sensing data, including airborne imagery and a LiDar-generated DEM (digital elevation model), will be used with this cruise information to engineer block layout, including the identification and design of retention areas/patterns, protected areas, road layout, and landings. Careful, high-utilization logging will take place on all harvest areas, followed by appropriate site preparation, and the implementation of site-specific regeneration strategies. Original cruise plots will be reestablished using GPS to monitor silvicultural effectiveness, benchmark growth/value gains against the original forest, and quantify long-term managed stand growth and yield. These sites will be used extensively as backdrops for public, industry, government, and professional stakeholder education, demonstration of state of the art intensive forest management science, and as working models of “enhanced wood supply areas”. As such, the project will serve as a catalyst for the implementation of enhanced forest productivity in the RMF and elsewhere.

### *Preliminary Results*

In spring of 2005, Block 18 was chosen as the first demonstration block for this project. Approximately half of this 250-ha block was cruised in May and June, with 70 plots providing forest vegetation and soils data. The overall standing forest on this portion of the block averaged an estimated 150 $m^3$/ha gross merchantable volume (GMV), or 139 $m^3$/ha net merchantable volume (NMV), with approximately 70% of these totals being conifer. The average number of stems per hectare (sph) was 910; 540 sph conifer and 370 sph deciduous. The most common ecosites (classed using the Northeast Forest Ecosite Classification Guide) were ES15 (19%; red maple mixedwood stand; Figure 10), ES9r (17%; white spruce, balsam fir, white cedar – moist) and ES10 (16%; poplar-black spruce, moist mixedwood).

Following the harvest of approximately 194 ha in July and August, 2005, reported volumes by Tembec Industries totaled 26,543 $m^3$ (137 $m^3$/ha) (NMV), consisting of 9,540 $m^3$ (49 $m^3$/ha) spruce, pine and balsam fir (SPF), 10,270 $m^3$ (53 $m^3$/ha) white birch, 3,187 $m^3$ (16 $m^3$/ha) aspen, and 3,546 $m^3$ (18 $m^3$/ha) cedar. Approximately 54 ha of the harvest area were mechanically site prepared (disc trencher) in October; further activities scheduled for the 2006 field season include additional mechanical site preparation, tree planting, and chemical site preparation.

## *Anticipated Benefits*

Enhanced Forest Productivity demonstration areas resulting from this effort will provide a mechanism for incremental refinements through adaptive management by presenting transparent testing grounds for operationally validating current and ongoing FRP products. These areas are also serving to provide working models of *enhanced wood supply areas*, enabling the feedback and interaction amongst public, corporate, and professional stakeholders necessary for identifying field concerns and barriers to enhanced fibre production, and for identifying solutions for broader regional and provincial implementation. In the long term, these areas will help validate the productivity gains being modeled to mitigate wood supply losses associated with *Ontario's Living Legacy* and fulfill wood-supply sharing goals of the *Room to Grow Strategy* by generating growth and yield data for stands managed under harvest-to-harvest sequences of silvicultural best practices. In short, the Enhanced Forest Productivity demonstration areas will contribute to the knowledge and experience necessary to address the very real and imminent wood shortages that face forest industry today.

## *Research team*

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## *Sponsors*

The following agencies have made this research possible: Canadian Ecology Centre – Forestry Research Partnership (Tembec, Canadian Forest Service, and Ontario Ministry of Natural Resources) and Millson Forest Service.

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For more information, see the Canadian Ecology Centre – Forestry Research Partnership website at www.forestresearch.ca, or contact Doug Pitt at dpitt@NRCan.gc.ca, (705) 541-5610.

***Implementation of Enhanced Forest Productivity: A Pilot Project on the Romeo Malette Forest***

# Introduction

In spring of 2005, the Forestry Research Partnership (FRP) embarked on its first on-the-ground expression of a strategy designed to increase wood supply in an ecologically sustainable context. The *Enhanced Forest Productivity Pilot Project on the Romeo Malette Forest* (EFPRMF) will comprise a series of demonstration areas that will operationally validate state of the art knowledge and new FRP research products, applied as harvest-to-harvest sequences of silvicultural best practices. With the goal of maximizing the productivity of these carefully selected "prime" sites, this project will merge high-tech inventory with leading-edge forest modeling, and silvicultural science with operational practice, to create flagship illustrations of how silviculture can be used to improve, restore, and diversify Ontario's forests. We hope that this project will ultimately act as a catalyst for enhanced forest productivity on the Romeo Malette Forest and other forests across Ontario.

## *Background*

The province of Ontario launched its 1999 land use strategy, *Ontario's Living Legacy*, to increase the number and size of parks and protected areas, as well as to help secure a stable long term wood supply for the forest industry. The FRP was created by the Ontario Forest Accord (a subset of the Living Legacy) in 2000 to focus applied research on the wood supply components of the *Accord* objectives. FRP activities are described in detail on its web site, http://forestresearch.ca.

The primary objective of the FRP program is to identify technology and techniques to allow Tembec to increase the annual allowable cut (AAC) on its licence areas by 10% within 10 years. The 10/10 target is to be achieved in the context of ecological sustainability, reduced operational costs, improved fibre utilization, and enhanced future fibre quality.

Extensive spatial modeling (Patchworks) has been undertaken on the Romeo Malette forest which indicates that the forecasted wood supply declines over time, projected in current forest management plans, can be arrested by implementing an aggressive intensive silviculture program on a limited proportion of the most productive sites on the forest landbase. This intensive program, strategically applied, will produce more fibre without negative impacts on other forest values, and without significant negative cost implications.

The EFPRMF is the first on-the ground manifestation of the FRP's strategy to increase wood supply in an ecologically sustainable context. It is a demonstration project, intended to stimulate discussion and interaction at the field level, in an operational context. The lessons learned from this demonstration will be applied to future projects having the same strategic objectives. The end goal is a well planned, integrated, enhanced forest productivity program that will achieve wood supply objectives, improve the understanding of resource sustainability, and effectively measure and assess the trade offs associated with forest management decisions involving multiple, interdependent values.

### *Project Objectives*

The objectives of this multi-year project are to:

1) *Provide a working model of an "enhanced wood supply area" for the purpose of direct demonstration of state of the art intensive forest management science for public, industry, government, and professional stakeholder education and input. The project is intended as a flagship and catalyst for the implementation of enhanced forest productivity in the RMF and elsewhere.*
2) *Provide for semi-operational testing, allowing evaluation of practical benefits and potential problems associated with full integration of advanced forest management practices, tools and technologies as derived from various FRP research initiatives. Operational testing is viewed as a critical step in the overall adaptive-management process leading to refinements in modeling criteria, data-acquisition for intensive planning and monitoring, advanced crop planning, aerial application decision support systems, and tracking of silviculture information required to develop standardized tools and guidelines for potential broader implementation across the boreal forest region.*
3) *Generate long-term growth and yield data for stands managed under harvest-to-harvest sequences of silvicultural best practices. Areas will be managed to maximize productivity through the combined effects of intensive pre-harvest planning, high-utilization logging, good stock selection, genetic improvement, high (>90%) stocking, timely and effective vegetation management, density regulation, insect and disease protection, etc. As such, growth response data will support validation of the gains currently being modeled to mitigate wood supply losses associated with Ontario's Living Legacy.*

# Methods

The proposed demonstration areas will encompass approximately 1000 ha (actual area will be a product of the site-selection process), over a 3-year implementation period. The project began by our matching Patchworks model identifications of prime sites with areas allocated for harvesting under the current forest management plan. The identified areas consist of sites that are candidates for intensive silviculture treatments (i.e., outside of habitation, riparian, and incompatible-values setbacks, with minimized user conflict, etc.), have potential for high productivity, and are situated in economic proximity to a processing facility. To date, we have sought forested areas, so that intensive planning can be implemented at the pre-harvest stage. However, for future areas, we will not overlook candidate sites that have recently been harvested, or existing young stands with well-documented history and strong potential for response to additional silvicultural interventions. A range of forest types will be considered, including mixedwoods. Candidate sites are field-verified for final selection.

### *Site layout*

New remote sensing data, including airborne imagery and a LiDar-generated DEM (digital elevation model), is used with cruise information to stratify the selected areas into polygons at least 10 ha in size, consisting of similar topography and site conditions. The polygons are then quantified and characterized in relation to Forest Ecosystem Classification criteria using a series of 0.04-ha circular plots located on a 200-m grid (1% cruise). Within these plots, the center is recorded with GPS, all living stems greater than 10 cm are measured for DBH, by species, and a representative dominant or codominant tree of the principle merchantable species measured for height and age. Understorey conditions are documented by estimating the percentage cover in the merchantable species < 10 cm DBH, tall shrub, low shrub, and herbaceous categories. In each of these categories, the 3 most common species are noted. Soil conditions are also be recorded. This information is being used:

- to evaluate site productivity based on dominant height-age relationships and the Forest Ecosystem Classification (FEC) System (vegetation and soils information);
- to estimate merchantable volumes by species and product for mill usage and as benchmarks for enhanced fibre production;
- to provide information for planning site-specific harvest, site preparation, regeneration operations, and crop plans;
- as inputs for Forest Vegetation Simulator (FVS) Ontario to develop benchmarks for site productivity, as well as the basis for future crop planning using the FVS Ontario model; and
- where possible, provide ground-truth data for enhanced inventory work being conducted with remotely-sensed data, with the goal of developing a less-costly means of operationally acquiring the information necessary for advanced planning in intensive forest management.

The cruise information, coupled with the remote sensing data, is then used to optimize road location and design each harvest block in terms of its desired future forest conditions. Blocks are then re-stratified into polygons at least 10 ha in size that consist of unique prescriptions for harvest (method, timing, equipment), structure retention (species, number of stems, pattern and/or patch size), site preparation (method, timing, equipment), and regeneration method (natural vs. artificial, species and stock selection). A regeneration target and crop plan is developed for each polygon, matched to site conditions. Site-specific silvicultural strategies are developed under this project.

### *Harvest and silviculture*

Operations will be carried out under normal Millson Forestry Service (MFS) operating conditions, with MFS crews and equipment. Careful, high-utilization logging will take place on all harvest areas, followed by appropriate site preparation, and the implementation of site-specific regeneration strategies. Residual trees/stands will only be left on site as a part of designed, pre-planned wildlife habitat, or targeted regeneration strategies. All other merchantable material, including white birch, will be harvested and utilized. All harvesting and site preparation equipment will be GPS-equipped for guidance (when necessary, for executing the operational plan) and mapping/recording of activities. All roads within EFP areas, except those that are winter-accessing lowland conifer, will be considered as permanent infrastructure and, as such, built to an appropriate standard[1].

The harvest block chosen to initiate this project at the time of the drafting of this report (Block 18) is conducive to a conifer-dominated regeneration objective. Depending on the nature of additional blocks chosen, greater emphasis may be placed on mixedwood or deciduous regeneration, if dictated by site. On Block 18, we are striving to regenerate with a mix of planting (80% of block area) and natural regeneration (10% of block area). The remaining 10% of the block will be involved in designed exclusion zones and retained structures. The decision to plant, naturally regenerate, or exclude/retain is being made on a site-specific basis, irrespective of existing FRI lineage. New inventory data (DEM, canopy model, and digital imagery) are being used to design and plan these features on the block, with final determinations being based on field verification.

Where planting is undertaken, our goal is to achieve > 90% stocking to 1.9-m spacing (2800 sph). All plantings will consist of random species mixes, examples including Sb-Ce, Sw-Sb, Sw-Pw, and Pw-Pr, with specific mixtures to be pre-defined in the silvicultural strategies, and locations to be pre-determined on a site-specific basis during planning. Crop plans for these planted areas will accommodate commercial thinning and be designed to maximize tree growth and product value. FVS and SDMDs will be used as tools to develop these stand-specific prescriptions.

Within planted areas, wildlife leave trees and structures are being confined to “islands” and “clumps” and generally not left as dispersed individual trees unless mature white pine and/or upland cedar (or other unique species/trees) are present. Islands are at least ¼-ha in size and consist of species and vertical structure that will allow wind firmness (e.g., selection will be stability-driven). Unstable overstorey trees are selectively harvested from the edges of islands, but these structures will otherwise remain as in-tact representations of the pre-harvest forest. Within the block, islands will fully represent the range of site conditions present and include wet or low-lying areas, fragile or inoperable areas, and steep slopes, to maximize wildlife use, ecosystem function, and diversity. Islands will not be over-sprayed with herbicide. Clumps consist of small clusters of advanced regeneration conifer (often spruce-fir) 2-4 m in height and are being left, when encountered during harvest, at a rate of approximately 1 per 2 ha of plantation. Mature trees may be stubbed around these clumps to add to habitat value and protect these clumps during skidding and site preparation operations.

Natural regeneration is being used to maintain a hardwood component in the EFPRMF areas, as well as unique species that are encountered. Sites capable of quality future hardwood production, containing aspen or white birch as a strong component in parent stands, may be left to regenerate naturally. Examples of unique species include upland white cedar, yellow birch, and black ash. Where such species occur, they are being incorporated in islands and retained, or silvicultural prescriptions applied to maintain their presence within the block (e.g., shelterwood, partial harvest, or seed-tree systems). On

[1] To date, this standard has been “tertiary” class, no gravel.

lowland conifer sites that exist within the block, CLAAG may be used, pending the presence of advanced regeneration. In natural regeneration areas, crop plans will maximize diversity, growth, and product value in these areas.

MFS is carrying out all regeneration activities under operational conditions (i.e. site preparation, greenhouse growing, stock delivery, production tree plant), in accordance with the timing, densities, etc., outlined in the plan. Regeneration targets will be verified by field inspection one year after regeneration efforts have been made. Areas requiring remedial measures will be GPS'd and treated as soon as practicable.

### *Long-term monitoring*

Permanent growth plots (PGPs, 0.04-ha, circular) will be established in the location of the original cruise plots and monitored through time to quantify productivity gains associated with the new forest and generate long-term growth and yield data. These plots will conform to existing PGP standards (FESSC 2002; OMNR *In Prep*.) and link with the provincial matrix of growth and yield plots to provide data to monitor and track silvicultural effectiveness and performance, as well as validate productivity gains for future wood supply calculations. Establishment, sampling, data analysis and reporting will take place over the three year fiscal period 2006-2008, with a long-term remeasurement strategy in place. By and large, this project will lead to plots being placed in conditions not already represented in the provincial matrix.

## Preliminary Results – Block 18 2005

Block 18 was the first of potentially 3 blocks chosen for the EFPRMF pilot. It satisfies all the criterion of being a "prime site" with its close proximity to the mill (25 km), high site quality, and suitability for conifer restoration. Block 18 is approximately 500 ha of which 194 ha were harvested last year. Prior to harvesting, 70 plots were cruised using the methodology described above. The following paragraphs summarize the findings in these plots:

### *Soil characteristics*

Block 18 generally has high quality soil that may be characterized as site class 1 for spruce and white pine. Soil on the 70 cruise plots was classified using the *Field Manual for Describing Soils in Ontario* (OCSRE 1993). Most of the soil parent material originates from glacial-fluvial/morainal deposits (90%, Figure 1), with a small component of organic soils (9%), and minor shallow-to-bedrock (1%). Terrain is mild, with 84% of the slopes classed as gentle (5-9% grade) or less (Figure 2), creating favorable harvesting and silviculture opportunities. The first 70 cruised plots had ideal microsite classification, with 90% of the terrain being slightly mounded or greater (Figure 3). Soil surface stoniness was varied; the most common class was moderately stony (30%; Figure 4) and 94% of the plots did not have any surface rocks present (Figure 5).

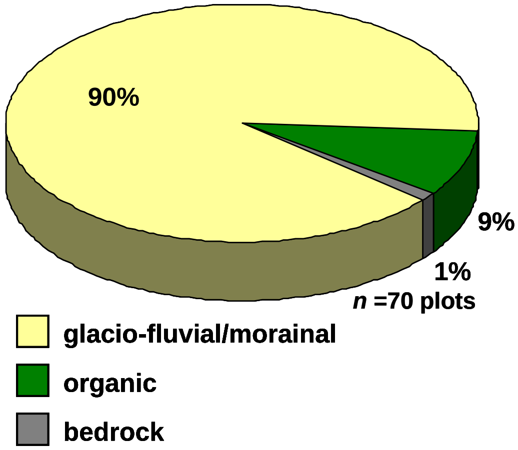


Figure 1. Parent Material

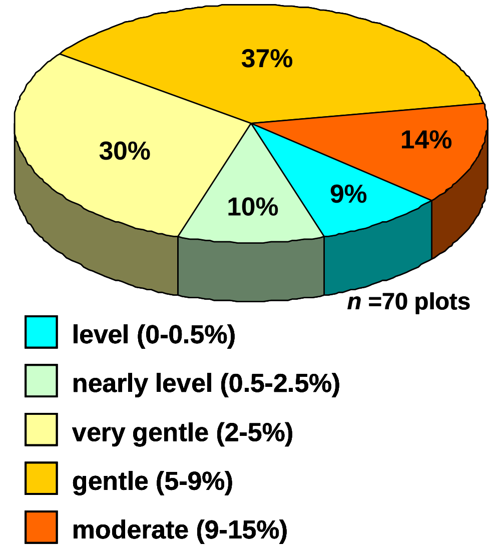


Figure 2. Slope Class

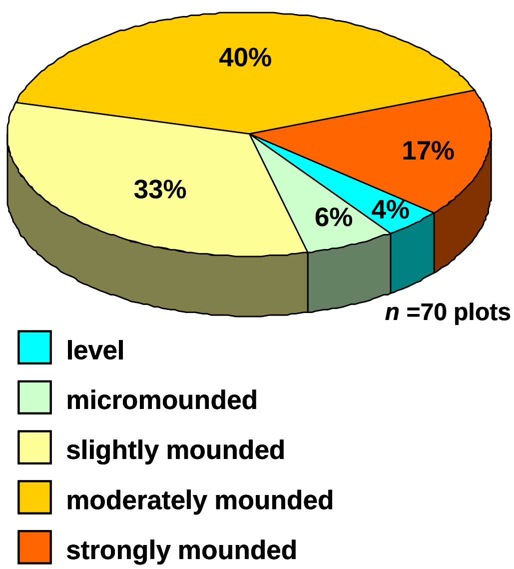


Figure 3. Microtopography

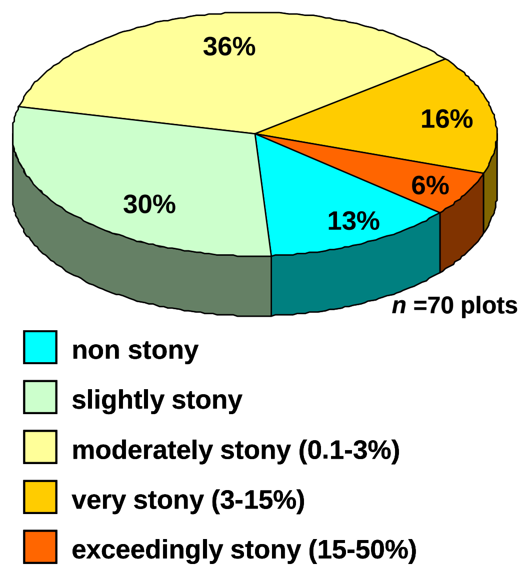


Figure 4. Surface stoniness

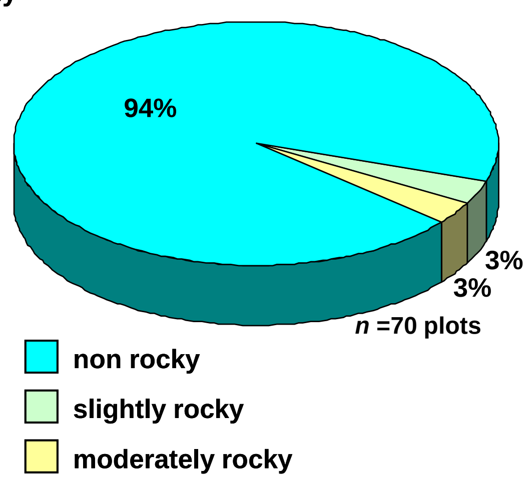


Figure 5. Rock outcrops

The most common classes of soil moisture found on block 18 were ideal for spruce regeneration; the soils were very moist (36%), moist (24%), and moderately moist (13%) (Figure 6). Approximately 17% of the sites were classed as very fresh to moderately dry, and thus favorable to white spruce, white pine, and red pine regeneration.

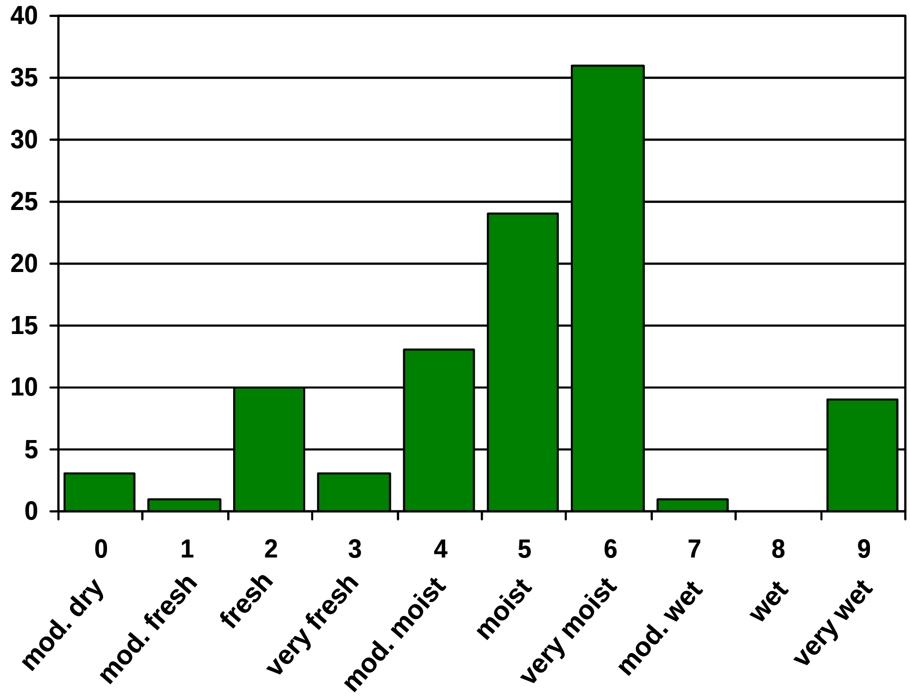


**Figure 6. Soil moisture regime (% of plots, *n* = 70)**

The average soil profile of block 18 was 87.3 cm deep (Figure 7). Layers present were L (2.0 cm), F (3.8 cm), H (2.6 cm), B 43.8 cm and C (32 $cm^+$). Gleying was infrequent, occurring in only 2 plots, while mottles were present in 54 plots at an average depth of 23 cm. Organic soils were present on 11% of the sites with an average depth of 78 cm.

There were no definite trends in the soil texture classes in the B-layer, except for a tendency towards more silt and clay, rather than sand (Figure 7). Coarse fragments were generally infrequent the B-layer (56% of plots), however, when present, were dominated by gravel (32%), followed by gravel and stones (7%), stony (4%), and very stony (1%). The C-layer was dominated by a higher sand content, with silty sand being the most common (42%), followed by sandy loam (22%), and sandy clay (13%). All of the plots had coarse materials present in the C-layer, consisting of gravel (39%), stony (35%), and gravel+stones (26%).

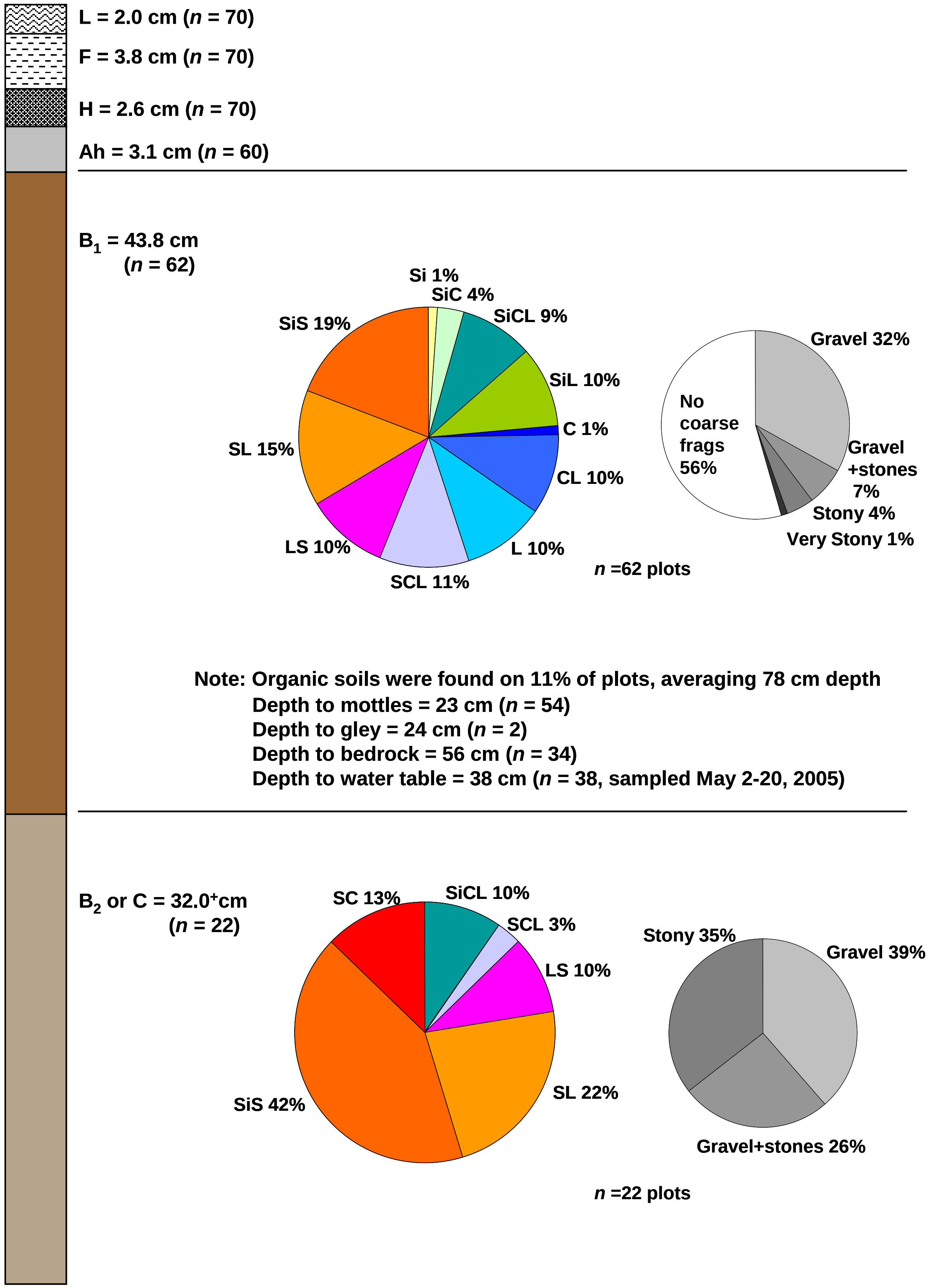


**Figure 7. Soil texture and profile**

## *Vegetation and Tree characteristics*

Ecosite was classified using the *Northeast Forest Ecosite Classification Guide* (NEFEC; 2000). The most common classes were ES15 (19%; red maple mixedwood stand; Figure 8), ES9r (17%; white spruce, balsam fir, white cedar – moist), ES10 (16%; poplar-black spruce, moist mixedwood) and ES13r (10%; white cedar-black spruce, organic soil).

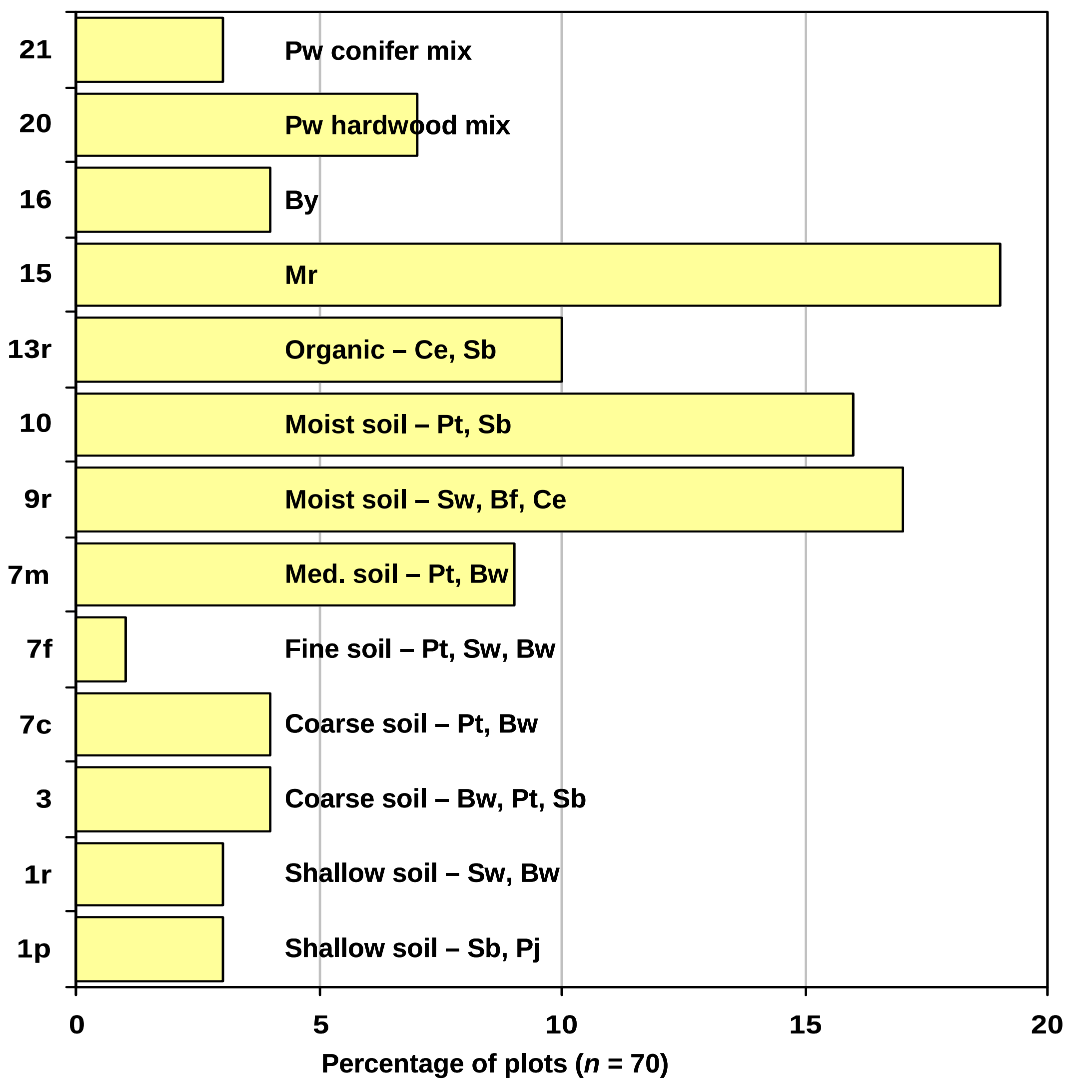


**Figure 8. Ecosite (NEFEC p. C8-36)**

Low shrubs provided an average of 11% ground cover in block 18, with Canada honeysuckle present in 76% of the plots and contributing 5% cover (Figure 9). The next most common species/groups were *Vaccinium spp.* (blueberry; present-43%; cover-1%), raspberry (present-29%; cover-1%) and Canada yew (present-19%; cover=1%).

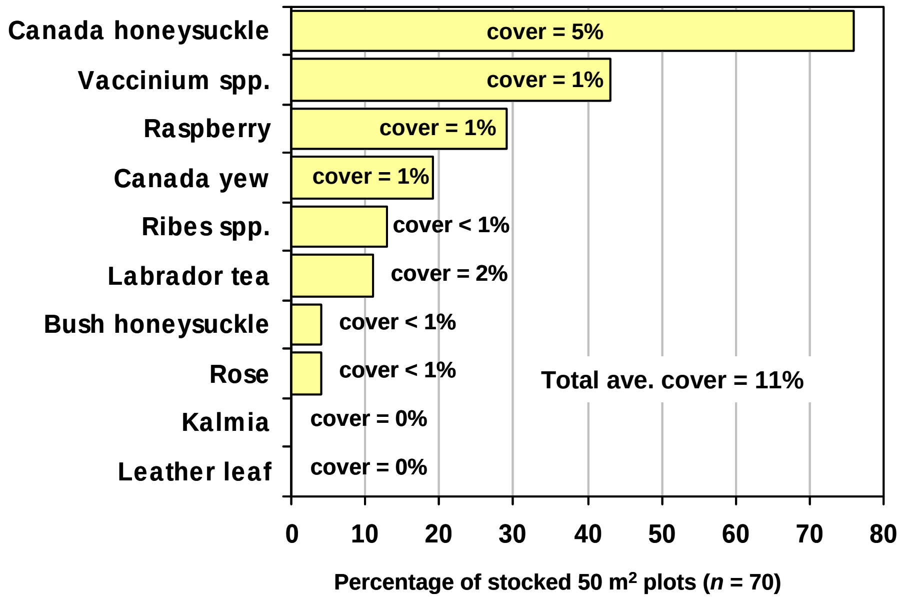


**Figure 9. Low Shrub Species**

Tall shrubs were numerous in block 18 (average stems per hectare (sph) 15,650; Figure 10), with mountain maple being dominant (8,000 sph) and present in the most plots (86%). Following mountain maple were beaked hazel (4,300 sph; 77%), choke cherry (500 sph; 41%), alder (1,500 sph; 40%) and mountain ash (500 sph; 30%).

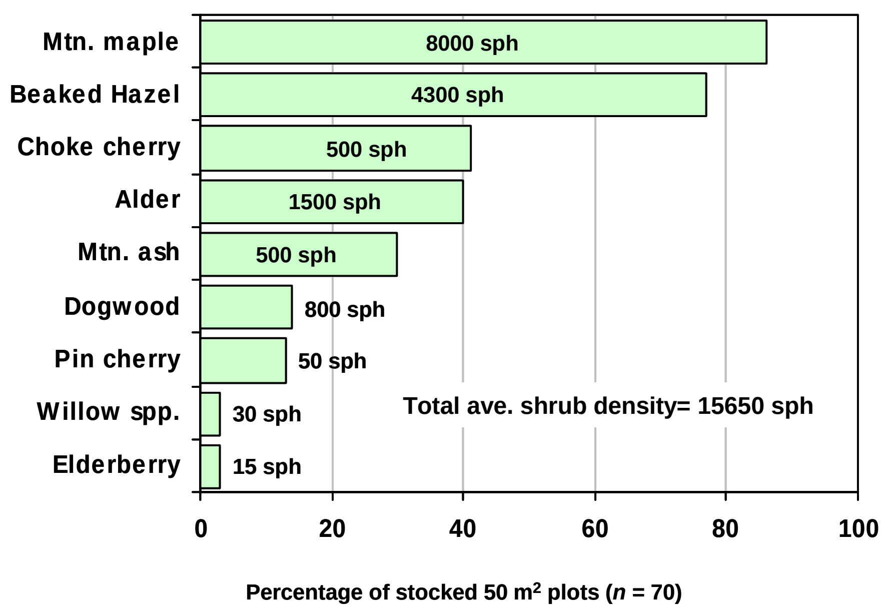


**Figure 10. Tall Shrub Species:**

Tree species with diameters at breast height (DBH) less than 10 cm were sampled for frequency in the understory. Per hectare, there were an average of 5,090 coniferous stems and 1,250 deciduous stems (Figure 11). Balsam fir was the most numerous at 2,820 sph and it was present in most plots (96%). Next were white spruce (250 sph; 46%), white cedar (1,700 sph; 46%), red maple (700 sph; 34%), white birch (270 sph; 31%), black spruce (300 sph; 26%), aspen (210 sph; 20%), black ash (100 sph; 4%), balsam poplar (6 sph; 3%) and larch (40 sph; 1%). Despite the presence of white pine in patches throughout the block, there were no young white pine saplings found in the plots. Historical activities on Block 18 appear to have created an environment unfavorable to white pine establishment.

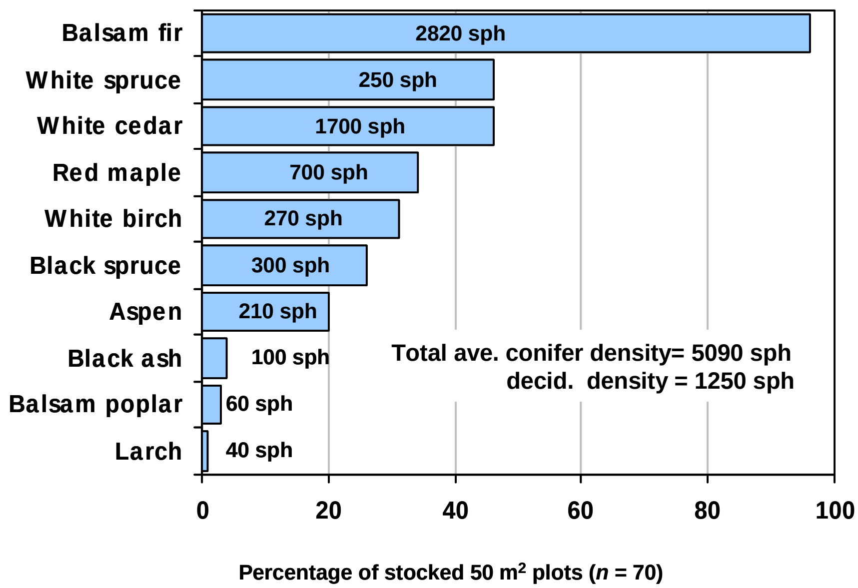


**Figure 11. Tree Species (DBH < 10 cm)**

**Figure 12. Evidence of the past forest; an old white pine stump on Block 18.**

Measuring the standing forest in each of the 70, 400m$^2$ plots (Table 1; Figure 13) resulted in an estimated average of 150.4 m$^3$/ha of gross merchantable volume (GMV) and 139.2 m$^3$/ha of net merchantable volume (NMV). White cedar had the most volume (57.9 m$^3$/ha – GMV), followed by white birch (28.4 m$^3$/ha – GMV), white spruce (26.0 m$^3$/ha – GMV), trembling aspen (15.3 m$^3$/ha – GMV) and black spruce (10.6 m$^3$/ha – GMV). There were some rarer species present (yellow birch, black ash, and white pine) in the sample, with low volume per ha, that were identified and set into reserves. The high amount of rarer upland cedar volume also prompted a reserve of cedar to be established.

The average number of sph in block 18 was 910 (Figure 14, with 540 conifer sph and 370 deciduous sph. Conifers had greater numbers in the smaller diameter classes (10 – 20 cm DBH) and the larger diameter classes (42 – 50+ cm DBH).

**Table 1. Cruise statistics for Block 18 (70 plots)**

| Species | SPH | SE | BA (m2/ha) | SE | GMV (m3/ha) | SE | NMV (m3/ha) | SE |
|---|---|---|---|---|---|---|---|---|
| Sw | 151 | | 4.8 | | 26.0 | | 25.3 | |
| Sb | 97 | | 2.2 | | 10.6 | | 10.3 | |
| Bf | 93 | | 2.0 | | 8.3 | | 7.2 | |
| Ce | 188 | | 14.2 | | 57.9 | | 52.1 | |
| La | 8 | | 0.2 | | 0.8 | | 0.8 | |
| Pw | 4 | | 0.2 | | 1.2 | | 1.1 | |
| **Conifer** | **541** | **47** | **23.6** | **2.7** | **104.8** | **11.7** | **96.8** | **10.5** |
| Pt | 51 | | 3.5 | | 15.3 | | 13.7 | |
| Bw | 271 | | 8.6 | | 28.4 | | 26.8 | |
| By | 9 | | 0.2 | | 0.4 | | 0.4 | |
| Ab | 7 | | 0.1 | | 0.2 | | 0.2 | |
| Mr | 29 | | 0.6 | | 1.3 | | 1.3 | |
| **Deciduous** | **367** | **13** | **13.0** | **1.2** | **45.6** | **4.5** | **42.4** | **4.1** |
| **TOTAL** | **908** | **37** | **36.6** | **2.1** | **150.4** | **9.7** | **139.2** | **8.7** |

**Figure 13. Students Mathieu Breault (left) and Yannick Loranger measure a large aspen on Block 18.**

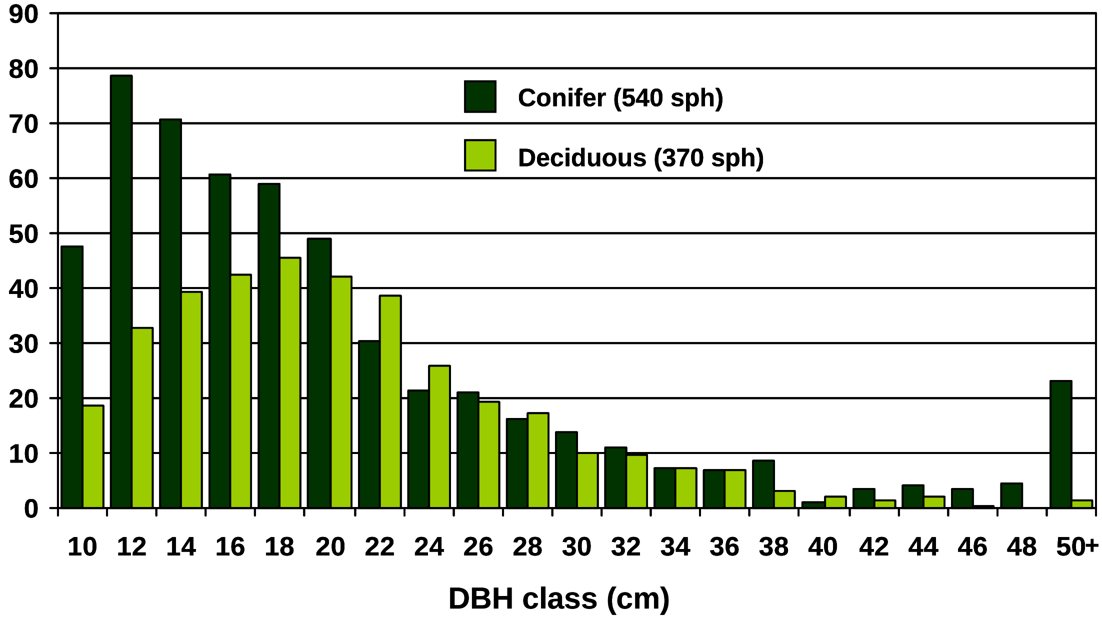


**Figure 14. Diameter distribution for Block 18 (2005 harvest area) (stems per ha)**

## *Harvesting Results*

In 2005, 194 ha were harvested in Block 18 (Figure 15). As described above, the silvicultural strategies being employed called for a combination of traditional dispersed retention (leaving solitary standing trees), and aggregate retention that maintains islands and peninsulas of wind-firm and representative (or rare) tree species/ecosystems that provide wildlife habitat, retain local forest genetics and act as a seed source. The aggregate retention areas (currently 11.7 ha or an average of 52 sph over the current cut block), will supplement dispersed retention that is used in Area 3 (white pine, cedar) and the conifer "clumps" (clusters of young 2-4-m tall advanced growth conifer, left at a rate of approximately one for every 2 ha of harvest area) that are left throughout all harvest areas. Combined, these structures are anticipated to enhance wildlife habitat and use, as well as contribute to both stand-level and forest-level diversity in the short and long-terms. Islands will not be oversprayed with herbicide; conifer clumps will be. Our goal is to leave 10% of the block in aggregate retention areas or islands. At this point in time, we are below this target.

While providing the above benefits, the aggregate retention also facilitates subsequent silviculture activities. For example, mechanical site preparation can occur in a thorough, systematic fashion, since operators are not forced to continuously go around single dispersed trees (Figure 16). Similarly, the aerial application of herbicides will be more targeted and uniform, since aircraft will be able to spray at optimum release height, instead of above residual trees.

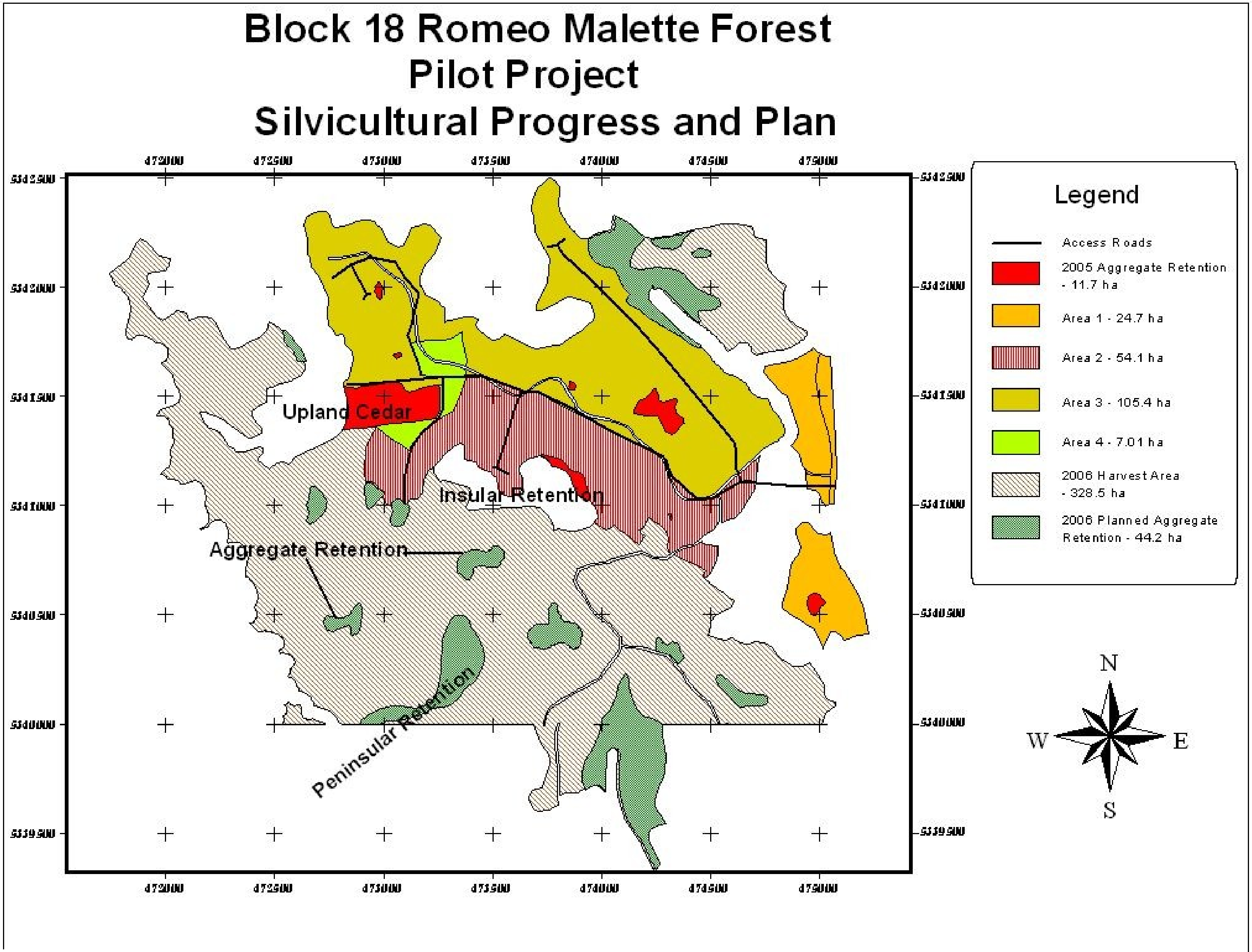


**Figure 15. Block 18 – 2005 harvested areas, retentions, and 2006 harvest area.**



**Figure 16. Residual retention strategies being used on Block 18.**

Harvested wood volumes recorded by Tembec Industries include 9,540 $m^3$ NMV for spruce, pine and balsam fir (SPF), 10,270 $m^3$ NMV for white birch, 3,187 $m^3$ NMV for aspen, and 3,546 $m^3$ NMV for white cedar (total 26,543 $m^3$). On a per hectare basis, the 2005 harvest averaged of 138 $m^3$ NMV. This is very similar to the NMV estimated from the 70 cruise plots reported above (Table 1), but a more direct comparison of the cruise-estimated and harvested volumes can be made if only the harvested cruise plots are included in the analysis (Table 2). All cruise-estimated volumes are based on Tembec Industries volumes tables. The SPF (9,520 $m^3$ - cruised), and trembling aspen (2,986 $m^3$ – cruised) estimates were within 6.5% of the harvested volume. The white birch and white cedar estimates were off a considerable amount, each for good reason. Tembec's white birch volume table uses top size of 16 cm, reflecting Grant Flakeboard's normal utilization standard. Since last year's harvest involved the full-tree chipping of white birch, including stems down to 10 cm DBH (Figure 17), it is not surprising that the existing local volume table underestimated the amount of birch present. We used Honer's (1983) volume tables for white birch to correct for this, resulting in a NMV of 11,679 $m^3$, which is within 12% of the reported harvested volume. The white birch chips were used by Tembec's Smooth Rock Falls paper mill, preventing 53 $m^3$ NMV/ha of white birch from being left standing on the block!

In contrast, harvested white cedar volume was 61% less than predicted (8,997 $m^3$ – cruised). This was due to the partial harvest of the white cedar stands (50% harvest, Area 4) and, possibly because the large upland cedar present on the block (Figure 18) were not representative of the cedar sample originally used to construct Tembec's local volume table.

**Table 2. Cruise Statistics for 2005 – Harvested area only (47 plots)**

| Species | SPH | SE | BA($m^2$/ha) | SE | GMV($m^3$/ha) | SE | NMV ($m^3$/ha) | SE | NMV Harvested ($m^3$/ha) |
|---|---|---|---|---|---|---|---|---|---|
| Sw | 183 | | 5.8 | | 31.1 | | 30.4 | | 49.4 |
| Sb | 75 | | 1.8 | | 9.0 | | 8.7 | | * |
| Bf | 104 | | 2.3 | | 9.8 | | 8.5 | | * |
| Ce | 116 | | 11.7 | | 51.5 | | 46.4 | | 18.4 |
| La | 0 | | 0 | | 0 | | 0 | | 0 |
| Pw | 5 | | 0.2 | | 1.6 | | 1.5 | | * |
| **Conifer** | **483** | **41** | **21.9** | **3.2** | **103.0** | **15.0** | **95.5** | **13.5** | **67.8** |
| Pt | 59 | | 3.9 | | 17.2 | | 15.4 | | 16.5 |
| Bw | 273 | | 8.7 | | 28.8 | | 27.2 | | 53.2 |
| By | 11 | | 0.2 | | 0.2 | | 0.2 | | 0 |
| Ab | 3 | | <0.1 | | <0.1 | | <0.1 | | 0 |
| Mr | 35 | | 0.7 | | 1.4 | | 1.4 | | 0 |
| **Deciduous** | **381** | **37** | **13.5** | **1.3** | **47.7** | **5.2** | **44.2** | **4.7** | **69.7** |
| **Total** | **864** | | **35.4** | | **150.7** | | **139.7** | | **137.5** |

* Total amount of spruce, pine and fir was 49.4 $m^3$/ha.

**Figure 17. Chipped white birch for the mill in Smooth Rock Falls.**

**Figure 18. Uniquely large upland cedar on Block 18.**

## *Silviculture plans for 2006*

The silvicultural plan for 2006 was created using the overall silvicultural vision for enhanced forest productivity areas, as described in the methods section above. The area harvested in 2005 will have 4 distinct silvicultural regeneration plans applied to it:

**Area 1**, (Figure 15) includes the two pieces on the front (east) of the block (24.7 ha) that were harvested prior to mid July 2005. This ground was left in clean condition following harvest and skidding and is the only portion of the 2005 cut that appears to be regenerating well to aspen and birch. We will assess this area mid growing season of 2006 and confirm the quality of this regeneration. At this time, we will decide to 1) allow this area to remain in natural hardwood production, 2) invoke a mixedwood regeneration strategy as part of a larger test of the Nokamic mulching system (strips would be mechanically and chemically site prepared (possibly with Velpar L®) in August of 2006, with the planting of 1,100 white spruce per ha in spring of 2007), or 3) if the area is deemed to have unsuccessful natural regeneration, it will be included in the August 2006 chemical site preparation program, with careful aerial application (GPS guidance and navigation) and monitoring of stream deposition by Dean Thompson (see expanded description under Area 3) .

**Area 2**, a total of 54.1 ha have been identified for spruce production. This area will be mechanically site prepared in fall 2005 (approximately half completed as of 21-12-05), planted in spring 2006, and chemically tended with Vision® in August of 2007 and, possibly, 2009. Mechanical site preparation will be disc trenching, with discs set at 1.9-m spacing. Planting will consist of a mixture of black and white spruce, with species selection matching microsite. Target density will be 2800 sph. White pine and cedar (if available) will be included in this density, randomly, at 10 and 5%, respectively. This area will have potential for first entry commercial thinning at age 25, with high-value conifer production being the long-term goal.

**Area 3**, the largest portion of the 2005 harvest area (105.4 ha) will be scheduled for mixed conifer production. The area will be chemically site prepared in early to mid August, 2006, using Vision Max®, applied by air, with GPS guidance and navigation equipment. Dean Thompson (CFS) will set up a monitoring program to collect DSS (Decision Support System) calibration data for the unique (low) release heights and features (aggregate retention) offered by this block.. Mechanical site preparation will take place in November 2006, using the same equipment and settings described for Area 2. Planting will take place in spring 2007. A random mixture of white pine, red pine, white spruce, black spruce, and cedar will be applied, with higher proportions of each species being planted on respective favorable sites. For example, white pine proportions will be increased from 10 to 30% in areas with high concentrations of residual mature white pine. Overall target planting density will be 2800 sph. These areas will be scheduled for light conifer release with Vision® in 2009 or 2010. This area will have potential for first entry commercial thinning at age 25, with high-value conifer production being the long-term goal. Aggregate retention areas ("islands") will not be over-sprayed.

**Area 4** is upland, old-growth cedar that was partially harvested with 50% removal. This area will be left for natural regeneration. The area will be chemically tended with Vision® in August of 2006, using a backpack, directed foliar application method (avoiding contact with established cedar regeneration) to reduce the mountain maple understory in this stand. The long-term goal will be to maintain this unique upland cedar ecosystem for both wildlife habitat and timber production. This managed portion will provide future contrast with the adjacent protected portion of the stand (approximately 8 ha).

## *Forcasted 2006 Field and technology transfer activities*

- Select new block(s) to reach target of 1000 ha – current to April 2006.
- Create harvesting and road plan for new blocks – April 2006
- Finish cruising block 18 – May 2006

- Complete harvest of block 18 – Late May, early June 2006
- Initiate cruising of new blocks – June 2006
- Reestablish plots for monitoring block 18- August 2006
- Initiate road construction in new blocks-August 2006
- Conduct field tours (as requested) - summer 2006

A proposal has been submitted to the Enhanced Forest Productivity Science Program of the Forestry Futures Trust entitled *Implementation of Enhanced Forest Productivity: A Pilot Project on the Romeo Malette Forest.* This proposal requests funding for the core work outlined in this report, as well as additional work that will bolster our monitoring efforts, including impacts on forest birds, with an emphasis on cavity nesting birds (Dr. Lisa Venier, GLFC), and verification and validation of herbicide efficacy and protection of off-target environmental values (Dr. Dean Thompson, GLFC). A decision on this proposal will be made on April 7, 2006.

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